

What is claimed is:

- 1 1. A method of forming a package comprising:
2 supporting a die on a flexible substrate;
3 encapsulating the die with a die encapsulant;
4 folding a flap of the flexible substrate over the die encapsulant;
5 introducing fold adhesive between the folded flap of the flexible substrate
6 and a surface of the die encapsulant; and
7 conforming the fold adhesive to the surface such that the fold adhesive is
8 substantially flat.
- 1 2. The method of claim 1 further comprising curing the fold adhesive, wherein
2 the fold adhesive has a volumetric cure shrinkage of less than about 0.8%.
- 1 3. The method of claim 2 wherein curing includes a partial cure of the fold
2 adhesive using a cure process with at least one of temperature and pressure, and
3 then a substantially full cure using a temperature batch cure process.
- 1 4. The method of claim 1 further comprising plasma cleaning to remove
2 releasing agents on the surface of the die encapsulant and on a front side of the
3 substrate before dispensing the fold adhesive.
- 1 5. The method of claim 1 wherein the fold adhesive is dispensed onto the die
2 encapsulant before the flexible substrate is folded over the die encapsulant.
- 1 6. The method of claim 2 wherein the volumetric cure shrinkage of the
2 adhesive facilitates a back side of the flexible substrate at the folded flap to become
3 a substantially flat upper surface of the package.

1 7. The method of claim 6 further comprising minimizing a z-height of the
2 flexible substrate.

1 8. The method of claim 1 further comprising supporting a top package upon the
2 folded flap of the flexible substrate.

1 9. The method of claim 8 further comprising:
2 providing solder joints between the top package and a substantially flat
3 upper surface of the folded flap of the flexible substrate; and
4 maximizing reliability of the solder joints by transferring a substantial
5 amount of stress from the solder joints to the fold adhesive, wherein the fold
6 adhesive is substantially compliant due to a Young's modulus of less than about 600
7 MPa at about room temperature, and an elongation at break greater than about 100%
8 at about room temperature.

1 10. The method of claim 1 wherein the fold adhesive is selected from the group
2 consisting of at least one of silicone, a silicone modified epoxy, a polyimide-
3 siloxane based system, vinyl terminated silane, hydrogen terminated silane,
4 platinum catalyst, fumed silica, polyimide siloxane, aliphatic epoxy, phenol
5 hardener, imidazole catalyst, an epoxy, an amine end capped silicone, phosphine
6 catalyst, a silica filler and other filler particles.

1 11. The method of claim 1 wherein the fold adhesive is selected from the group
2 consisting of at least one of silicone, a silicone modified epoxy, and a polyimide-
3 siloxane based system.

1 12. The method of claim 1 wherein the fold adhesive is selected from the group
2 consisting of at least one of vinyl terminated silane, hydrogen terminated silane,
3 platinum catalyst, fumed silica and other filler particles.

1 13. The method of claim 1 wherein the fold adhesive is selected from the group
2 consisting of at least one of polyimide siloxane, aliphatic epoxy, phenol hardener,
3 and imidazole catalyst.

1 14. The method of claim 1 wherein the fold adhesive is selected from the group
2 consisting of at least one of an epoxy, an amine end capped silicone, phosphine
3 catalyst, and a silica filler.

1 15. A package comprising:
2 a flexible substrate with a first region and a second region;
3 an encapsulated die supported by the first region, the second region of the
4 flexible substrate folded over the surface of the encapsulated die; and
5 a conformable fold adhesive introduced between the encapsulated die and
6 the flexible substrate.

1 16. The package of claim 15 further comprising a top package supported by the
2 flexible substrate at a substantially flat upper surface of the flexible substrate
3 adjacent the second region.

1 17. The package of claim 15 wherein the conformable fold adhesive is at least
2 one of a paste and a film.

1 18. The package of claim 15 wherein the conformable fold adhesive is dispensed
2 directly on the encapsulated die.

1 19. The package of claim 15 wherein after curing, a back side of the flexible
2 substrate at the second region becomes a substantially flat upper surface of the
3 package.

- 1 20. The package of claim 15 wherein the fold adhesive is selected from the
2 group consisting of at least one of silicone, a silicone modified epoxy, and a
3 polyimide-siloxane based system.
- 1 21. The package of claim 15 wherein the fold adhesive is selected from the
2 group consisting of vinyl terminated silane, hydrogen terminated silane, platinum
3 catalyst, fumed silica and other filler particles.
- 1 22. The package of claim 15 wherein the fold adhesive is selected from the
2 group consisting of polyimide siloxane, aliphatic epoxy, phenol hardener, and
3 imidazole catalyst.
- 1 23. The package of claim 15 wherein the fold adhesive is selected from the
2 group consisting of an epoxy, an amine end capped silicone, phosphine catalyst, and
3 a silica filler.
- 1 24. The package of claim 15 wherein the conformable fold adhesive has a
2 volumetric cure shrinkage of less than about 0.8%.
- 1 25. The package of claim 15 wherein the conformable fold adhesive has a
2 Young's modulus of less than about 600 MPa at about room temperature.
- 1 26. The package of claim 15 wherein the conformable fold adhesive has an
2 elongation at break greater than about 100% at about room temperature.
- 1 27. A system comprising:
2 a flexible substrate with a first region and a second region;
3 an encapsulated die supported by the first region, the second region of the
4 flexible substrate folded over the surface of the encapsulated die;

5 a conformable fold adhesive introduced between the encapsulated die and
6 the flexible substrate; and
7 at least one of an input device and an output device coupled to the
8 encapsulated die.

1 28. The system of claim 27, further comprising:
2 a top package supported by the flexible substrate at a substantially flat upper
3 surface of the flexible substrate adjacent the second region.

1 29. The system of claim 27, wherein the system is disposed in one of a
2 computer, a wireless communicator, a hand-held device, an automobile, a
3 locomotive, an aircraft, a watercraft, and a spacecraft.

1 30. The system of claim 27, wherein the encapsulated die is selected from a data
2 storage device, a digital signal processor, a micro controller, an application specific
3 integrated circuit, and a microprocessor.